

Evolving Directions: Enhancing Aviation Safety Through Regulation, Education and Awareness

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Introduction

In Canada we enjoy an enviable aviation safety record and our Civil Aviation safety program has been cited by the International Civil Aviation Organisation as one of the best in the world. However, with the predicted increase in air transportation and the probability that this will bring with it an attendant increase in the accident rate, we clearly cannot afford to maintain the status quo. To remain successful we must constantly challenge ourselves to improve the safety standard and work towards achieving a positive shift in the accident rate.

This paper will examine Transport Canada's efforts to enhance aviation safety through regulation, education and awareness. Particular emphasis will be placed on Flight 2005, our strategic planning document, and the initiatives that the maintenance and manufacturing branch has introduced to meet the targets contained there in. Insight will also be offered into where the program is going, and the future projects we will be undertaking, to ensure we meet future challenges and continue to raise the safety level.

Flight 2005: Altering Course

In his book, *Managing the Risks of Organizational Accidents*, James Reason discusses the evolving role of the regulator. He states: "...there has been a shift away from laws that specify the means by which safe working should be achieved to focus on the attainment of certain safety goals." At Transport Canada, we have certainly adopted this approach to rule making. In 1996, we completely revised the aviation regulations with the promulgation of the Canadian Aviation Regulations (CARs) and adopted the performance based regulatory framework.

The publication of *Flight 2005: A Civil Aviation Safety Framework for Canada*, in 1999 moved Transport Canada further in this direction, with the adoption of the safety management philosophy as the governing principle for the whole of Civil Aviation. Flight 2005 is Transport Canada's strategic plan for the next five years. It details where we are going, how we will get there, and the criteria we will use to measure the efficacy of our programs. In effect, we have, as Dr. Reason noted, shifted our focus to meet attainable safety goals, whilst allowing the industry the flexibility to determine how it will meet these challenges.

Flight 2005 contains two key results:

- continued improvement on the high level of aviation safety in Canada, and
- A high level of public confidence in our Civil Aviation Program.

At face value these may appear to be platitudes; they probably form the core of every regulator's goals and objectives. However, in Flight 2005 we measure the key results against a set of program objectives that detail decreases in accident rates and provide concrete criteria for measuring the effectiveness of our initiatives. To facilitate this, each branch in the Civil Aviation program must provide a business plan outlining how they will contribute to the attainment of the goals set out in the plan and must adhere to the goals established in their plans.

Flight 2005 represents a fundamental shift in the way we, as a regulatory authority, do business. The crux of this change involves the promulgation of six evolving directions

that pave the way for this movement. Whilst some of these strategies are a continuance of existing Civil Aviation programs, others represent a completely new approach. The evolving directions are:

- *Adopting a data-driven approach in developing strategies to enhance safety;*
- *Using a risk-based approach to resource allocation;*
- *Emphasising the consultative approach with the aviation community;*
- *Implementing safety management systems in aviation organizations;*
- *Taking account of human and organisational factors in decision-making;*
- *Pro-actively communicating with targeted audiences on aviation safety.*

To understand why this represents a significant shift in the way we do business, a cursory review of several of the new directions is required. First of all - *adopting a data-driven approach in developing strategies to enhance safety*. From a program perspective it is important for us to gain a better understanding of what is happening in the Canadian aviation environment. We have to understand what events are happening and where they are occurring. If we have no benchmark to evaluate our systems, and those of the operators we certify, we have no factual data to analyse and learn from. It has been said, "*Mistakes are a fact of life. It is the response to error that counts.*"¹ The point being we have no means of determining where we should be targeting our interventions.

In order to achieve this objective, we are looking at the establishment of an error reporting system for incidents and accidents across the entire Civil Aviation Regulatory program. The working group examining this issue is also charged with defining a set of criteria for reporting events without fear of punitive action. Not only will this provide us with the information we require to make data driven decisions, it will help us identify weakness in the regulations and verify the effectiveness of the Civil Aviation Program.

The second evolving direction is *using a risk-based approach to resource allocation*. Every delegated officer at Transport Canada is being given the Q850 Canadian Standards 7-step risk management training program. The program will probably be expanded to include all non-delegated personnel as well. A significant component of the risk assessment process involves knowing the facts. If we relate this to the *data driven approach*, we can start to see the links between the different elements in Flight 2005. To fully understand the inherent risks of any project we must understand the historical component related to the task. Having a complete knowledge of past problems, risks and incidents related to the task, significantly improves the inspector's ability to make a far more inclusive assessment of the inherent risks.

The third element and perhaps the most important evolving direction, is the *implementation of safety management systems within Civil Aviation*. It is generally accepted that most accidents are not just the result of a single failure, they are usually the result of systemic deficiencies that lead to a failure or breakdown in an organisation's defense mechanisms. At Transport Canada we view the implementation of an effective safety management system as the number one tool in mitigating this problem. Moreover, we are recognising the interconnection of these layers within the various operational areas. Indeed, just as maintenance deficiencies can create latent problems for operations: an operational deficiency can create latent problems for an

¹ N. Giovanni, *Black Feeling/Black Talk/Black Judgement* (1970).¹

aerodrome operator. As such we are moving towards the regulation of safety management programs for all entities encompassed within the Civil Aviation regulatory framework.

In the Aircraft Maintenance and Manufacturing area we have already introduced safety management program requirements for larger operators, and will be considering the possibility of extending this requirement to smaller operators in the future. Our colleagues in the Commercial and Business Aviation Branch have also introduced safety management program requirements for all of their certificate holders and the other branches will be following suit. From an oversight perspective this represents a significant shift for Transport Canada, instead of involving ourselves in the day to day activities of operators, we will focus our involvement on regular audits of the findings of the safety management program.

The shift towards safety management is also intended to address the issue of *human and organizational factors in safety management practices*. Thus far, the focus has been on compliance to the regulatory framework, which did not directly address these factors. In an effort to build awareness of these issues, Transport Canada will undergo an active campaign of public forums addressing the issue of human factors and safety management programs.

Altering Course: The Branch-Wide Perspective

From a Branch-wide perspective we have also altered course. Our contribution to the attainment of the goals outlined in Flight 2005 involves:

- human factors training;
- the introduction of safety management program requirements;
- the accountable executive regulations; and
- increased research into human performance from the maintenance perspective.

Our human factors training requirements include factors that influence human performance such as fatigue, stress and communication, a human performance model and error management.

The maintenance quality and safety program is an extension of the existing quality assurance requirements detailed in Car 573 and CAR 706. In addition to the existing quality assurance requirements, the maintenance safety management program must include the following elements:

- a maintenance safety plan;
- a listing of the quality assurance manager's functions;
- safety management training requirements;
- data collection procedures;
- incident analysis procedures, and
- reporting procedures.

Perhaps the most important component of the maintenance safety program is data collection and incident reporting. This is important for numerous reasons, not the least of which is the constant feedback from the workplace on existing and emerging unsafe conditions. Most error management systems are reactive; they focus on failures rather than the latent problems within the system that can eventually lead to accidents. Workers on the shop floor are ideally positioned to recognize these situations, however, without an efficient data collection and incident recording system this

knowledge is lost. Once in place, however, it is important to remember that the system must provide for employee feedback in the form of an acknowledgment that the report has been received, a report of the result of the incident analysis and a progress report of any corrective action that has been taken.

Our intent in introducing the program was not to reinvent the wheel. We looked at existing systems such as quality assurance on the maintenance side and flight safety programs on the operations side and simply combined these programs, adding the missing elements. The reason for this is clear: we wanted the industry to understand that they are already employing many of the techniques used in a safety management programs; they just need to pull the elements together into a comprehensive program.

A unifying and essential element of this regulatory package is the inclusion of the accountable executive. This element is important because it assigns a level of responsibility for safety deficiencies identified by the *program* at the senior management level. In effect, the accountable executive must assume responsibility for the system. Safety management involves a mindset that encourages cooperation, communication and empowerment of people. This can only be achieved when top management is supportive, both economically and philosophically, of the safety program.

If there were ever doubts about the role of accountable executive in the safety management construct, it is interesting to note that in 80-90% of all incidents, management has a direct control over the contributing factors that lead to human error². Whilst the different levels of management in the company make the working level decisions, the Accountable executive approves these decisions. In effect, the accountable executive determines the form the organization will take, the priorities it will promote, the business plan, and schedule the organization will follow. In addition, he or she controls the purse strings when it comes to investing in equipment and establishing the rates of pay; and perhaps more importantly, the Accountable executive establishes the company's culture. In effect, the company takes on the personality of the accountable executive. Logically, then, it would follow that if the President or CEO is committed to safety, the organization will do what is required to promote safety. In some cases, however, economics drive management decision making, often to the detriment of the safety level. The concept of the accountable executive vests a level of responsibility in the senior management level of the company. Thereby making the certificate holder ultimately responsible for safety deficiencies within the company.

From a Branch perspective we have tackled the goals encompassed in Flight 2005 with a three tiered approach. In effect, we have addressed each of the successive layers in the system through regulation, education or awareness initiatives. If we put this in the context of the "Swiss Cheese" model¹ of Defences, and look at the different layers in the system that can impact human performance, it is clear that a single level approach is not appropriate in the systems approach to safety. We must address all of the layers: the individual, the system and the organisational culture. Our regulatory package addresses these issues, whilst providing the industry with enough flexibility to tailor the program to meet their own needs.

² F. Bird and G. Germaine, *Practical Loss Control Leadership*, (USA: Det Norske Veritas, 1996)

What are the Benefits?

We often hear the statistic that 80% of all incidents have a human error component, whilst only 20% can be attributed to mechanical failings. Moreover, we have all heard dire predictions of a projected upward climb in the accident rate if we maintain the status quo and continue to experience increased air traffic. Obviously, it is in the area of human error that we can make the greatest impact in terms of reducing the accident rate.

As a regulatory authority we have a responsibility to provide the tools, the guidance and the regulatory framework that promotes safety first and foremost. Safety management provides a pro-active approach to managing safety and reducing human errors in aviation maintenance. Not only does this make sense in terms of reducing maintenance incidents and accidents, it also makes economic sense: safe organizations are more efficient organizations. By approaching problem areas in a proactive manner, issues such as fatigue are acknowledged, dealt with, and monitored on an on-going basis before the latent failure becomes an active failure.

From a regulatory perspective we want companies to start thinking about “why” the problem occurred and not just “what” happened. We want the industry to identify problem areas before they become systemic weaknesses and apply corrective measures. Not only does this benefit the operator; it also redefines the role of the regulator in the day to day operations of the company. We will simply provide oversight of the system, thereby allowing for the allocation of resources in other areas.

Future Directions

There are certain issues that stand out as a natural progression from the regulatory initiatives we have already introduced. These programs include a study of fatigue levels and duty times in the maintenance industry. Another is the development of advisory material that supports the safety management program. We will also be looking at the development of a system for sharing information related to incidents and accidents between Government and industry

Fatigue Study

In terms of research, we have a major project underway at this time - a study of fatigue in aviation maintenance personnel. This research is specific to the Canadian industry and will take into account the variables that characterize the Canadian industry, such as geographic diversity and variety of operations.

When we talk about fatigue in aviation, we usually think in terms of the pilot world. We know that fatigue induced human performance errors are a causal factor in many operational incidents and accidents. We tend to focus on the pilot issue because of the immediate consequences of a fatigue-induced error. It's a simple formula: pilot falls asleep, aircraft crashes. The connection between fatigue and maintenance error is not as well defined, nor as well documented. This is in spite of the fact that the physiological challenges are still the same: shift work, night work and long working periods. The link between fatigue and performance impairment is somehow perceived as less critical, because the maintainer is not seen as being on the “front line”. The fact remains, however, that many maintenance tasks are performed in the middle of the night when the propensity for human performance error is at its greatest. This assertion is

borne out by a growing body of evidence documenting performance degradation at the circadian low point – the middle of the night.

Fatigue related performance degradation is not isolated just to shift work and night work; it is also associated with long shift durations and the number of consecutive days worked. Professor Drew Dawson, at the University of South Australia, has equated fatigue-related impairment to alcohol impairment. His research has shown that after 17 hours of wakefulness, fatigue related impairment is equivalent to a blood alcohol level of 0.05%. After 24 hours of wakefulness this increases to 0.10% - well over the legally prescribed limit for operating a motor vehicle.

There are many options available for handling fatigue issues. From the perspective of the individual there are measures that can be taken to manage fatigue. This might be as simple as informing one's self of the symptoms of fatigue, or as complex as a night shift adaptation program. Fatigue management, however, is a shared responsibility between the employee and the employer. In effect, the employer should ensure that all work-related causes of fatigue are effectively managed and the employee should ensure that all non work-related causes of fatigue are minimized.

Accepting responsibility for fatigue management is an ideal scenario, whether it exists or not is another issue. From the Government perspective, the issue of fatigue management is not likely to be as simple as dictating duty time through regulation. After all, whilst duty time regulations do limit hours of work; it is impossible to regulate the hours that one sleeps. It is a common misperception that time off means restorative rest. Only sleep will restore alertness and only the individual can ensure that they get sufficient sleep.

Having said this, we cannot afford to rule out duty time regulation as an option especially given the increasing awareness of the role of fatigue in human error. Before addressing this issue, therefore, we have undertaken a research project to determine if there actually is a fatigue problem in the Canadian aviation maintenance industry. To this end Transport Canada has commissioned a study to assess current working hours in the industry. The study is part of a three pronged initiative that addresses fatigue induced performance impairment. The project also includes an assessment of those maintenance tasks most impacted by fatigue. The third element is a fatigue management program.

The results of the study will be used as starting point for a CARAC Technical Committee working group looking at fatigue and duty time limitations. The working group will determine the most appropriate course of action; this could include awareness and education programs or duty time regulation. We are already pushing ahead with the development of a fatigue awareness program. This will be used in combination with the maintenance task fatigue-impairment study as an education and awareness tool. Even if the Committee decides that duty time regulation is the most appropriate course of action, the Minister of Transport does not currently have the legal authority to make such regulations. An amendment to Aeronautics Act, giving the Minister of Transport the authority to regulate the working hours of the maintenance personnel, would be required. Transport Canada has already initiated an amendment to the Act, which, if accepted, will confer this authority on the Minister. For the reasons

given earlier, however, having the authority, does not necessarily mean that it will be used.

Any issue that directly affects both the professional and personal life of the individual is bound to be controversial. The issue of fatigue, and performance degradation as a result of fatigue, is no exception to this rule. The issue of fatigue is complex and multi faceted, with no definitive solutions, however, it has been said that “...*people who stay in the middle of the road...get run over*”³; and as a regulatory authority we have a responsibility to show leadership in this issue. Hence our move towards collecting the data required to make an informed decision regarding our options and our commitment to involve the maintenance industry in defining the solution to the problem.

Additional Research

Much research has been conducted in the area of maintenance human factors. In the Canadian context, however, we have very little information specific to our environment. As such, we are proposing future human factors research to assess the most common errors in Canadian maintenance operations. There is a clear need from the perspective of the industry and Transport Canada, to gain a better understanding of the most common errors made in aircraft maintenance. This research would recognise the peculiarities of the Canadian industry and provide specific knowledge of the impact these characteristics have on human performance.

The approach suggested by Dr. Reason in *Managing the Risk of Organizational Accidents* emphasizes the importance of identifying not just the errors committed by personnel, but the latent conditions that contribute to the cause of these errors. Any research conducted, therefore, will consider both elements. Otherwise, the knowledge we gain will be incomplete and the action plans to reduce errors will fail. As such, another component of this project is a review of the error reporting systems of various nations for overlapping data that is representative of maintenance errors made in Canada. Certain classes of errors in maintenance operations may have overlap with errors committed by other personnel in other aviation operations.

Summary

From the regulatory perspective we can only do so much. We often hear it said we can not regulate safety: this is quite true. We can only establish an environment that promotes safety. Often times this does not involve regulation; it involves education, awareness and consultation. Any initiatives we undertake, therefore, will be done with the full knowledge and cooperation of the industry. At Transport Canada, I believe we have come a long way to achieving this with the CARAC process and open discussions with the industry. Our role is to promote “Safety first and foremost”. Our aim, therefore, is to improve safety through proactive management rather than reactive compliance with regulatory requirements. As aviation organizations generally possess an in-depth knowledge of the risks inherent to their operations, they are well placed to manage them and to achieve positive shifts in their safety culture. Transport Canada’s role is to provide these organizations with information on the safety management concept and to facilitate its implementation.

³ Aneurin Bevan. (London: *Observer*, 9 Dec. 1935).³

We've provided a regulatory framework with a different emphasis: operators are being asked to consider the human and organizational factors in their operations. They are being asked to consider all facets of their operation, and to shift their safety assessment accordingly. This involves viewing the system as an interwoven network, instead of viewing the parts in isolation from each other. They must now consider the impact each individual unit has on the whole operation. Furthermore, under the new regulations, management will be held accountable for doing this.

We are now moving into another phase. We're increasing our specific knowledge of the Canadian aviation maintenance environment, so we can target the need for Government intervention at a more distinct level. We've come a long way towards addressing these issues, however, the challenges still exist. Moreover, they will continue to exist until we make human factors an integral part of the way we do business. Human and organizational considerations must be automatically assessed in all the activities we undertake. If we continue to consider human factors in isolation from the entire system, we propagate the notion that making a mistake is something unusual. We all make mistakes, we are human and the sooner we accept this, the sooner we will start to make an impact on the primary cause of incidents and accidents - human error.

ⁱ J. Reason, *Managing the Risks of Organizational Accidents*, (Aldershot: Ashgate Publishing, 1997)